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Title:

Global maritime distress and safety system(GMDSS) - Part 6: Narrowband direct-printing telegraph equipment for the reception of navigational and meteorological warnings and urgent information to ships (NAVTEX) - Operational and performance requirements, methods of testing and required test results

Introductory note

IMO revised the performance standard for NAVTEX at the Maritime Safety Committee 77th session (MSC77) to allow NAVTEX systems without an integral paper printer. The NAVTEX may now display the result on a suitable screen as long as it has sufficient memory. The revision standard is in this area only, as well as checking the Normative references and including an Introduction and a revised Scope.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**GLOBAL MARITIME DISTRESS AND
SAFETY SYSTEM (GMDSS) –****Part 6: Narrowband direct-printing telegraph equipment
for the reception of navigational and meteorological warnings
and urgent information to ships (NAVTEX) – Operational and performance
requirements, methods of testing and required test results**

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The text of this standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date¹⁾ indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be either

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

1 INTRODUCTION

NAVTEX provides shipping with navigational and meteorological warnings and urgent information by automatic display and/or print out from a dedicated receiver.

NAVTEX is a component of the IMO/IHO World-Wide Navigational Warning Service (WWNWS) defined by IMO Assembly resolution A.706(17), as amended, and the WMO Manual on Marine Meteorological Services, Part *Ibis*, Provision of warnings and weather and sea bulletins (GMDSS application). It has been included as an element of the Global Maritime Distress and Safety System (GMDSS).

The original NAVTEX specification allowed for equipment with integral printers and precluded the fitting of equipment which relied on other ways of recording and displaying NAVTEX data. The use of Liquid Crystal Displays and other Visual Display Units is now ubiquitous on ship's bridges and this revision of the specification allows for their use in displaying NAVTEX data.

IMO Resolution MSC.148(77) states that the equipment should comprise radio receivers, a signal processor and:

either:

- a) an integrated printing device; or
- b) a dedicated display device, printer output port and a non-volatile message memory; or
- c) a connection to an integrated navigation system and a non-volatile message memory.

¹⁾ The National Committees are requested to note that for this publication the maintenance result date is

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS)

Part 6: Narrowband direct-printing telegraph equipment For the reception of navigational and meteorological warnings and urgent information to ships (NAVTEX) – Operational and performance requirements, methods of testing and required test results

2 Scope

This part of IEC 61097 specifies the minimum performance requirements, technical characteristics and type-testing requirements for narrowband telegraph equipment for the reception of navigational and meteorological information as required by Regulation IV/7.1.4 of the 1988 amendments to the 1974 International Convention for Safety of Life at Sea (SOLAS), and which is associated with IEC 60945. When a requirement in this standard is different from IEC 60945, the requirement in this standard takes precedence.

This standard incorporates the performance standards of IMO Resolution MSC.148(77), the technical characteristics of ITU-R Recommendation M.540, takes account of the IMO Resolution A.694(17) and conforms with the ITU Radio Regulations where applicable.

All text of this standard, whose meaning is identical to that in IMO Resolution MSC.148(77) and ITU-R Recommendation M.540 will be printed in *italics* and the Resolution/Recommendation and paragraph number indicated between brackets.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60945: *Marine navigation and radio communication equipment - General requirements - Methods of testing and required test results*

IEC 61162 –1, –2 *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*

IMO *Safety of Life at Sea (SOLAS) Convention* (1974), as amended (GMDSS)

IMO Resolution A.694(17) (1991) *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids*

IMO Resolution MSC.148(77) (2003) *Revised performance standards for narrow-band direct-printing telegraph equipment for the reception of navigational and meteorological warnings and urgent information to ships (NAVTEX)*

IMO Publication - *NAVTEX Manual*

IMO Resolution MSC/Circ.1122 *Adoption of the revised NAVTEX manual*

ITU-R Recommendation M.540-2: 1990, *Operational and technical characteristics for an automated direct printing telegraph system for promulgation of navigational and meteorological warnings and urgent information to ships*

ITU-R Recommendation M.625-3: 1995, *Direct-printing telegraph equipment employing automatic identification in the maritime mobile service*

4 Definitions and abbreviations

For the purpose of this International Standard, the following definitions and abbreviations apply.

4.1 Definitions

4.1.1

LORAN-C

is a radio-navigation service provided for U.S. coastal, the continental U.S. and most of Alaska

4.1.2

NAVTEX

is a system for the broadcast and automatic reception of maritime safety information by means of narrow-band telegraphy

4.1.3

Test script

is a text file containing a number of NAVTEX messages formatted as defined in 6.5. The STF is a particular example of a test script

4.2 Abbreviations

ASCII	American Standard Code for Information Interchange
CER	character error rate
EMC	electromagnetic compatibility
EUT	equipment under test
HMI	human – machine interface
INS	integrated navigation system
IMO	International Maritime Organization
ITU	International Telecommunication Union
PC	performance check
PT	performance test
RTC	real time clock
SAR	search and rescue
STF	standard test file
STS	standard test sentence
USB	Universal Serial Bus
UTC	Co-ordinated Universal Time

5 Performance requirements

5.1 Introduction

(148/A.1.1) *The equipment, in addition to meeting the requirements of the Radio Regulations, the provisions of Recommendation ITU-R M.540 applicable to shipborne equipment and the general requirements set out in resolution A.694(17), and specified in IEC 60945 shall comply with the revised IMO performance standards for NAVTEX equipment Resolution MSC 148(77).*

(148/A.2.1) *The equipment shall comprise radio receivers, a signal processor and: either*

- a) *an integrated printing device; or*
- b) *a dedicated display device, printer output port and a non-volatile message memory; or*

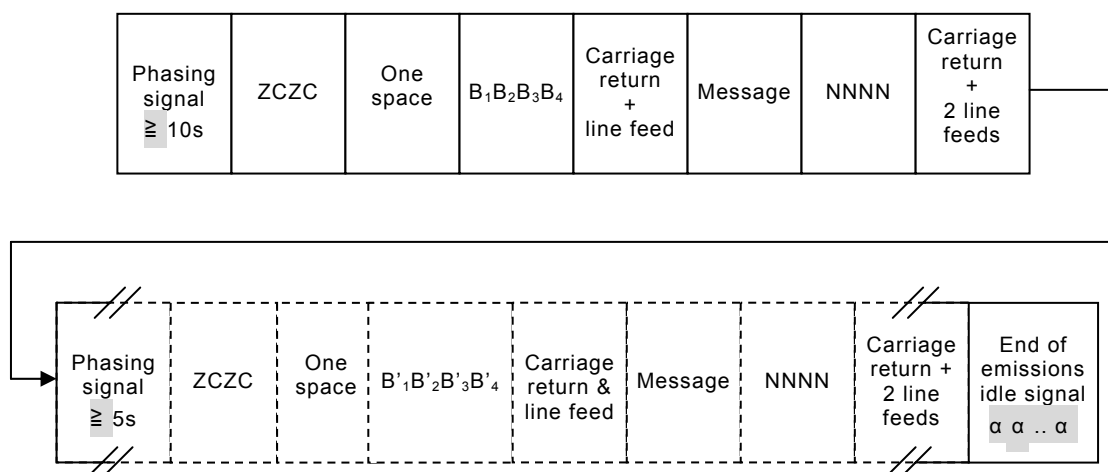
Note: Where there is no printer, the dedicated display device shall be able to be located in the position from which the ship is normally navigated.

- c) *a connection to an integrated navigation system (INS) and a non-volatile message memory.*

5.2 General characteristics

(540/AII.2) *The equipment shall be capable of receiving messages in the collective B-mode of the direct printing system specified in ITU-R Recommendation M.625, annex I,4.*

(540/AII.3) *The technical format of the transmission shall be in accordance with ITU-R Recommendation M.540, Annex II,3 as follows:*



where:

ZCZC defines the end of the phasing period

B_1 character is a letter (A-Z) identifying the transmitter coverage area.

B_2 character is a letter (A-Z) for each type of message as follows:

- A navigational warning
- B meteorological warning
- C ice report
- D search and rescue information/piracy and armed robbery
- E meteorological forecast
- F pilot message

- G AIS
- H LORAN-C message
- I reserved presently not used
- J SATNAV message
- K other electronic navigational aid system message
- L navigational warning (additional)
- M to Y reserved presently not used
- Z QRU (no message on hand)

B₃B₄ characters are the serial number of the message between 01 and 99.

5.3 Specific characteristics

5.3.1 B₁ and B₂ characters

(540/All.2.1) The B₁ characters *identifying the different transmitter coverage areas and the B₂ characters identifying the different types of messages are defined by IMO and chosen from table I of ITU-R Recommendation M.625, combination numbers 1-26.*

- a) Ship equipment shall be capable of automatically rejecting unwanted information using character B₁.
- b) Ship equipment shall be capable of disabling print-out or display of selected types of messages using character B₂ with the exception of messages with B₂ characters A, B, D and L.
- c) If any facility is rejected (transmitter coverage area) or disabled (type of message) the extent of any such limitation shall be clearly indicated to the user (see 5.3.7).

5.3.2 B₃ and B₄ characters

(540/All.2.2) *B₃ B₄ is a two-character serial number for each B₂, starting with 01 except in special cases where the serial number 00 is used (see 5.3.5).*

5.3.3 Preamble

(540/All.3) *The printer or message store shall only be activated if the preamble B₁ B₂ B₃ B₄ is received without errors.*

5.3.4 Repetition of printing/display

(540/All.4) *Facilities shall be provided to avoid printing, storage or display of the same message several times on the same ship, when such a message has already been satisfactorily received.*

(540/All.5) *The necessary information for these measures shall be deduced from the sequence B₁ B₂ B₃ B₄.*

5.3.5 Mandatory printing/display

(540/All.6) *A message shall always be printed, stored and displayed if B₃ B₄ = 00 and if it is transmitted by a coast station that the equipment is programmed to select.*

(540/All.2.3) *The characters ZCZC B₁ B₂ B₃ B₄ need not be printed / displayed.*

5.3.6 Reception of messages with character errors

5.3.6.1 Messages with character error rate of $> 4\%$ and $\leq 33\%$

The EUT shall store the message (non-printing EUTs) or message identification (printing EUTs) but shall allow the message/message identification to be replaced if it is subsequently received with lower error rate.

An EUT with an integral printer shall print the test messages indicating a character error rate of $\leq 33\%$.

An EUT with an integral display shall display the test messages indicating a character error rate of $\leq 33\%$.

5.3.6.2 Messages with character error rate of $> 33\%$

The EUT shall not store or print messages if the received character error rate $> 33\%$. See Annex B.

5.3.7 Controls and indicators

(148/A.3.1) Details of the coverage areas and message categories which have been excluded by the operator from reception and or display shall be readily available.

It shall be possible to exclude at least four different message categories. It shall not be possible to exclude message categories A, B, D & L.

(694/A.3) The number of operational controls, their design and manner of function, location, arrangement and size shall provide for simple, quick and effective operation. The controls shall be arranged in a manner which minimizes the chance of inadvertent operation.

All operational controls shall permit normal adjustments to be easily performed and shall be easy to identify from the position at which the equipment is normally operated. Controls not required for normal operation shall not be readily accessible.

Adequate illumination shall be provided in the equipment or in the ship to enable identification of controls and facilitate reading of indicators at all times. Means shall be provided for dimming the output of any equipment light source which is capable of interfering with navigation.

The design of the equipment shall be such that misuse of the controls shall not cause damage to the equipment or injury to personnel.

If a unit of equipment is connected to one or more other units of equipment the performance of each shall be maintained.

Where a digital input panel with the digits 0 to 9 is provided, the digits shall be arranged to conform with relevant ITU-T recommendations. However, where an alphanumeric keyboard layout, as used on office machinery and data processing equipment, is provided, the digits 0 to 9 may, alternatively, be arranged to conform with the relevant ISO standard.

5.3.8 Programmable control memories

(148/A.6.3) Information for location (B_1) and message (B_2) designators in programmable memories shall be permanently stored in non-volatile memory.

Note: Location (B_1) and message (B_2) designators are described in 5.3.1

5.3.9 Alarms

(148/A.7) *The receipt of search and rescue information ($B_2 = D$) shall give an alarm at the position from which the ship is normally navigated. It shall only be possible to reset this alarm manually.*

The EUT may either contain an integral alarm sounder or a pair of relay contacts for the provision of an external sounder.

If an additional alarm is provided at the equipment to indicate, for example, the reception of navigational and/or meteorological warnings, it shall be capable of being suppressed.

If an additional alarm is provided it shall be distinguishable from a search and rescue alarm.

The audible volume of the alarm shall be 75 – 85 dBA.

If a pair of relay contacts is provided to switch an external sounder on for an alarm condition then the relay contacts must be free of earth.

The alarm condition shall be reported via an ALR command on the INS serial port (See annex C)

5.3.10 Test facilities

(148/A.8) *The equipment shall be provided with a facility to test that the radio receiver, the display device/printer and non-volatile message memory are functioning correctly.*

5.4 Interfaces

(148/A.9.1) *The equipment shall include at least one interface for the transfer of received data to other Navigation or Communication equipment.*

(148/A.9.2) *All interfaces provided for communication with other Navigation or Communication equipment shall comply with IEC 61162 series of standards.*

(148/A.9.3) *If there is no integrated printer, the equipment shall include a standard printer interface (for example an RS232, Centronics, USB interface for an FX80 type printer, or other serial protocols and support for other printer types).*

New IEC 61162 sentences used to interface the EUT to an INS are defined in Annex C.

5.5 Receiver

5.5.1 Number of receivers

(148/A.4.1) *The equipment shall contain one receiver operating on the frequency prescribed by the Radio Regulations for the international NAVTEX system (518 kHz). The equipment shall contain at least one other receiver capable of working at the same time as the first one on at least two other frequencies recognised for the transmission of NAVTEX information. The first receiver shall have priority in the display or printing of received information. Printing or displaying of messages from one receiver shall not prevent reception by the other receiver.*

5.5.2 Receive Frequencies

The recognised receive frequencies shall be 490 kHz, 518 kHz and 4209,5 kHz.

Where the second receiver can be switched between operating frequencies, this shall be done both manually and via the INS port.

5.5.3 Sensitivity

(148/A.4.2) *The receiver sensitivity shall be such that for a source with an e.m.f. of $2\mu\text{V}$ in series with a non-reactive impedance of 50Ω (equivalent to -107dBm), the character error rate is below 4%.*

5.6 Display

If a display is included as part of the EUT then the following requirements shall be met.

5.6.1 User Interface

There shall be a display mode that clearly shows the user which transmitter coverage area (B_1) and message types (B_2) are currently selected for each receiver.

There shall be controls for adjusting the display illumination and contrast settings.

There shall be an indication of which receiver(s) are currently receiving.

New search and rescue (SAR) messages shall be displayed immediately that they are received and stored, and shall cause an alarm to be set. SAR messages shall be displayed until they are acknowledged by the cancellation of the alarm.

The reception and storage of new messages other than SAR messages shall be clearly indicated to the user by a method declared by the manufacturer.

It shall be possible to select transmitter coverage area (B_1) and message types (B_2) independently for message storage to non volatile memory, for message output to the INS port and for message output to the printer port.

5.6.2 Number of characters displayed per line

(148/A.5.1) *The display device shall be able to display a minimum of 32 characters per line.*

5.6.3 Number of lines displayed

(148/A.5.3) *The display device shall be able to display at least 16 lines of message text.*

5.6.4 Display requirements

(148/A.5.2) *If a dedicated display device is used, the following requirements shall be met:*

- a) *an indication of newly received selected messages shall be immediately displayed until acknowledged or until 24 hours after receipt; and*
- b) *newly received selected messages shall also be capable of being displayed.*

5.6.5 Visibility of display

(148/A.5.4) *The design and size of the display device shall be such that displayed information is easily read under all conditions by observers at normal working distances and viewing angles.*

This requirement shall apply for all displayed information received from any of the receivers, whether in English or in any other national language or any other supported alphabet.

5.6.6 Automatic line feed

(148/A5.5) *If automatic line feed entails division of a word, this shall be indicated in the displayed text.*

5.6.7 End of message display

(148/A.5.6) *When displaying received messages on a display device, a clear indication of the end of a message shall be given by automatically adding line feeds after the message or including some other form of delineation.*

5.6.8 Corrupt characters

(148/A.5.7) *The equipment shall display an asterisk if the character is received corrupted.*

5.6.9 Printer interface message selection requirements

(148/A.5.8) *Where the printer is not integrated, it shall be possible to select the following data to be output to the printer interface:*

- a) *all messages as they are received;*
- b) *all messages stored in the message memory;*
- c) *all messages received on specified frequencies, from specified locations or having specified message designators;*
- d) *all messages currently displayed; and*
- e) *individual messages selected from those appearing on the display.*

5.7 Integral printer

If a printer is included as part of the EUT then the following requirements shall be met.

5.7.1 Number of characters printed per line

(148/A.5.1) *The printer shall be able to print a minimum of 32 characters per line.*

5.7.2 Automatic line feed

(148/A5.5) *If automatic line feed entails division of a word, this shall be indicated in the printed text.*

5.7.3 End of message display

(148/A.5.6) *The printer or printer output shall automatically insert line feeds after completing print of the received message.*

5.7.4 Corrupt characters

(148/A.5.7) *The equipment shall print an asterisk if the character is received corrupted.*

5.7.5 General printer requirements

The integral printer:

- a) *shall print easily legible signs and produce a level of acoustic noise < 60 dBA;*
- b) *shall print the message received on paper. Changing the paper or printing mechanism, if required, shall be a simple operation. The paper and printing capacity shall be sufficient to enable at least 200,000 characters to be printed;*

- c) shall be provided with an alarm to indicate that the paper has nearly run out or has run out;
- d) shall provide temporary storage for partially printed messages. If any message is incompletely printed because the paper has run out or the printer is out of order, the message shall be stored in the memory and printed once new paper has been loaded. Memory storage of further new message identifications shall be inhibited if there is no paper available in the printing device

5.7.6 Printer message selection requirements

It shall be possible to select the following data to be output to the integral printer:

- a) all messages as they are received;
- b) all messages received on specified frequencies, from specified transmitter coverage areas or having specified message type designators

5.8 NAVTEX message memory

5.8.1 Equipment without integral printers

These requirements shall apply to equipment that does not contain an integral printer such as devices incorporating an integral display.

5.8.1.1 Number of messages

(148/A.6.1.1) For each receiver fitted it shall be possible to record at least 200 messages of average length 500 characters (printable and non-printable) in non-volatile message memory. It shall not be possible for the user to erase messages from memory. When the memory is full, the oldest messages shall be overwritten by new messages.

5.8.1.2 Message tagging

(148/A.6.1.2) The user shall be able to tag individual messages for permanent retention. These messages may occupy up to 50 of the required minimum of 200 x 500 character message slots and shall not be overwritten by new messages. When no longer required, the user shall be able to remove the tag on these messages which may then be overwritten in normal course.

5.8.1.3 Automatic erasure

(148/A.6.2.2) After between 60 and 72 h, a message and message identification shall automatically be erased from the store (unless tagged for permanent retention). If the number of received messages exceeds the capacity of the store, the oldest message and message identification shall be erased.

5.8.2 Equipment with integral printer

These requirements shall only apply to equipment that contains an integral printer.

5.8.2.1 Number of messages

(148/A.6.2.1) The equipment shall be capable of internally storing at least 200 message identifications for each receiver provided.

5.8.2.2 Automatic erasure

(148/A.6.2.2) After between 60 and 72 h, a message shall automatically be erased from the store. If the number of received messages exceeds the capacity of the store, the oldest message shall be erased.

5.9 Power Supplies

The equipment shall be powered from one of the ship's main sources of electrical energy (power) as defined by the manufacturer.

(694/A.4) Equipment shall continue to operate in accordance with the requirements of this Publication in the presence of variations of power supply normally to be expected in a ship.

Means shall be incorporated for the protection of equipment from the effects of excessive current and voltage, transients and accidental reversal of the power supply polarity.

If provision is made for operating equipment from more than one source of electrical energy, arrangements for rapidly changing from one source to the other shall be provided but not necessarily incorporated in the equipment.

5.10 Durability and General Construction

The equipment shall be of rugged construction, any externally mounted components shall be suitable for use in exposed shipboard locations.

The design and materials used for the equipment, including mounting devices, cables, antennas, displays, printers, and other components shall be suitable to ensure reliable operation in the maritime environment.

(694/A.5) Equipment shall be capable of continuous operation under the conditions of various sea states, ship's motion, vibration, humidity and temperature likely to be experienced in ships.

5.11 Interference

Consideration shall be given to the radio frequency fields (e.g., shipborne radars and other radio transmitters) that the equipment will be subjected to when mounted on a vessel.

(694/A.6) All reasonable and practicable steps shall be taken to ensure electromagnetic compatibility between the equipment concerned and other radiocommunication and navigational equipment carried on board in compliance with the relevant requirements of SOLAS.

Mechanical noise from all units shall be limited so as not to prejudice the hearing of sounds on which the safety of the ship might depend.

Each unit of equipment normally to be installed in the vicinity of a standard compass or a magnetic steering compass shall be clearly marked with the minimum safe distance at which it may be mounted from such compasses.

5.12 Safety Precautions

(694/A.7) As far as is practicable, accidental access to dangerous voltages shall be prevented. All parts and wiring in which the direct or alternating voltages or both (other than radio frequency voltages) combine to give a peak voltage greater than 55 V shall be protected against accidental access and shall be isolated automatically from all sources of electrical energy when the protective covers are removed. Alternatively, the equipment shall be so constructed that access to such voltages may only be gained after having used a tool for this purpose, such as a spanner or screwdriver, and warning labels shall be prominently displayed both within the equipment and on protective covers.

Means shall be provided for earthing exposed metallic parts of the equipment but this shall not cause any terminal of the source of electrical energy to be earthed.

All steps shall be taken to ensure that electromagnetic radio frequency energy radiated from the equipment shall not be a hazard to personnel.

5.13 Maintenance

(694/A.8) The equipment shall be so designed that the main units can be replaced readily, without elaborate recalibration or readjustment.

Equipment shall be so constructed and installed that it is readily accessible for inspection and maintenance purposes.

(694/A.8.3) Adequate information shall be provided to enable the equipment to be properly operated and maintained. Operating and servicing manuals shall :

- a) be written in English;*
- b) identify the category of the equipment or units to which they refer;*
 - 1) in the case of equipment so designed that fault diagnosis and repair down to component level are practicable, provide full circuit diagrams, component layouts and a component parts list; and*
 - 2) in the case of equipment containing complex modules in which fault diagnosis and repair down to component level are not practicable, contain sufficient information to enable a defective complex module to be located, identified and replaced. Other modules and those discrete components which do not form part of the modules shall also meet the requirements of .1) above.*

5.14 Marking and Identification

(694/A.9) Each unit of the equipment shall be marked externally with the following information which shall be clearly visible in the normal installation position:

- a) identification of the manufacturer;*
- b) equipment type number or model identification under which it was type tested;*
- c) serial number of the unit;*
- d) the safe distance of the equipment from the magnetic compass;*
- e) approval or certification information as required by the cognizant authority; and*
- f) any hazardous voltage or warning labels*

5.15 Source of UTC

The equipment may optionally use an externally provided source of UTC or an internal RTC to provide timing data for handling message ageing.

6 Test conditions

6.1 General

The EUT shall, unless otherwise agreed, be set up by the test laboratory following instructions contained in the user/installation manual. The test laboratory shall ensure that the EUT is operating normally before testing commences.

The tests to this standard may be performed on one or more units of the EUT as agreed between manufacturer and test laboratory. At least one EUT shall in addition to its normal operation be provided with:

- a) a test point at the processor output to the printing device (EUTs with an INS or printer interface shall utilize them for the tests); the level and format of the signal shall be stated by the manufacturer;
- b) suitable means to either output to the printing device or give access to examine with an external device the contents of the message storage and/or message identifier storage; the means shall be stated by the manufacturer;
- c) a method of clearing all stored messages and/or message identifiers from non-volatile memory; and
- d) a method of pre-loading a message and/or message identifier file into non-volatile memory by an external device so that the non-volatile memory may be filled or nearly filled with messages. This file shall be provided by the manufacturer and shall be referred to as the 'standard test file (STF)' in this document.

The test laboratory shall be capable of:

- a) generating NAVTEX transmissions, on each specified receive frequency, with all possible variations of B₁ B₂ B₃ B₄ characters in accordance with the technical format specified in ITU-R Recommendation M.540. The calibrated apparatus shall also be capable of generating incorrect signals, and
- b) generating the standard test signals contained in 6.5 for transmission to the EUT.

No adjustments are permitted to the EUT throughout the complete test program except for removal and application of primary power as required by the test procedures, changing of paper rolls where appropriate and changes to internal settings where required to allow the test to be conducted.

A performance test is required at various points in the test sequence. An inability to meet the performance test or failure of any test required by the test procedure shall be considered a critical failure, and the test shall be terminated.

A performance check is required at various points in the test sequence. An inability to meet the performance check or failure of any test required by the test procedure shall be considered a critical failure, and the test shall be terminated.

The values of all parameters of EUT conditions/states measured or observed, respectively, during each of the tests prescribed in the procedures of this Publication, shall be duly recorded and submitted to the appropriate national authority as part of the required test approval data set. The measurement accuracy of each value (or set of values) shall also be reported in the test data. A completed summary of test results shall also be submitted to the appropriate national authority.

Except as specified by the test procedures, opening of the unit is not allowed.

6.2 Performance test

The performance test (PT) is a receiver call sensitivity test (refer to 10.1) with the test signal at the applicable STS level.

6.3 Performance check

A performance check (PC) is a receiver call sensitivity test (refer to 10.1) with the test signal +6 dB relative to the applicable STS level.

6.4 Normal and extreme conditions

6.4.1 Normal test conditions

6.4.1.1 Temperature and humidity

The normal test conditions are defined in terms of temperature, humidity and supply voltage.

Temperature and humidity shall be within following range:

Temperature +15° to +35° C

Humidity 20 % to 75 %

When it is impractical to carry out the test under the conditions stated above a note to this effect, stating the actual temperature and relative humidity during the tests, shall be added to the test report.

6.4.1.2 Power supply

The normal test power supply voltage shall be within a tolerance of $\pm 3\%$ relative to the nominal voltage of one (or any) of the ship's power supplies for which the equipment is designed. For a.c. supplies, the test power supply frequency shall be within ± 1 Hz of the nominal frequency. Refer to IEC 60945 Clause 5.2.1.

The nominal supply voltage and frequency are the declared or any of the declared voltages or frequencies for which the EUT is designed.

6.4.2 Extreme test conditions

6.4.2.1 Environmental

The test conditions are described in the environmental tests in the following paragraphs.

6.4.2.2 Power supply

Table 1 - Extreme power supply variation

Power supply	Voltage variation %	Frequency variation %
a.c.	± 10	± 5
d.c.	+30 -10	Not applicable

Refer to IEC 60945 Clause 5.2.2 for further information.

6.4.3 Excessive test conditions

These conditions exceed the extreme test conditions in which the EUT is required to operate, with or without performance degradation, as indicated herein.

- a) Excessive current is defined as greater than normal working current.
- b) Excessive voltage is defined as 50 % greater than the nominal voltage.

Protection shall be provided against such excesses at an appropriate level chosen by the manufacturer and, when activated, may require the EUT to be reset, for example by fuse replacement. The power supply shall be adjusted to cause activation of the protection and after EUT reset, a performance check under normal test conditions shall be carried out.

Power supply miss-connections are also regarded as excessive conditions. Where appropriate, the EUT shall be subjected to an input from a power supply of reversed dc polarity or improper ac phase sequence for a period of 5 min. After completion of the test, and reset of the protection of the EUT, if required, the power supply shall be connected normally and a performance check shall be carried out.

6.5 Standard test signal

The Standard Test Signal (STS) shall be in accordance with ITU-R Recommendation M.625, annex I,4, collective B-mode. It shall consist of an F1B radio-frequency signal modulated with a frequency shift of ± 85 Hz centered on the receive frequency (490, 518 or 4209,5 kHz),

(540/All.10) *The transmitter frequency tolerance for the mark and space signals shall be better than ± 10 Hz.*

The technical format of the transmission shall be in accordance with ITU-R Recommendation M.540, annex II,3 and shall contain the following traffic information signals as the message content:

For 490 kHz :

(figure shift) 4 9 0 (space)
 (letter shift) K H Z (space) (carriage return) (line feed)
 (letter shift) A B C D E F G H I J (space)
 (letter shift) K L M N O P Q R S T (space)
 (letter shift) U V W X Y Z (figure shift) 1 2 3 4 (space)
 (figure shift) 5 6 7 8 9 0 ? : . , (space)
 (figure shift) - () ' = / + (space) (carriage return) (line feed)

For 518 kHz :

(figure shift) 5 1 8 (space)
 (letter shift) K H Z (space) (carriage return) (line feed)
 (letter shift) A B C D E F G H I J (space)
 (letter shift) K L M N O P Q R S T (space)
 (letter shift) U V W X Y Z (figure shift) 1 2 3 4 (space)
 (figure shift) 5 6 7 8 9 0 ? : . , (space)
 (figure shift) - () ' = / + (space) (carriage return) (line feed)

For 4209.5 kHz :

(figure shift) 4 2 0 9 (space)
 (letter shift) K H Z (space) (carriage return) (line feed)
 (letter shift) A B C D E F G H I J (space)
 (letter shift) K L M N O P Q R S T (space)
 (letter shift) U V W X Y Z (figure shift) 1 2 3 4 (space)
 (figure shift) 5 6 7 8 9 0 ? : . , (space)
 (figure shift) - () ' = / + (space) (carriage return) (line feed)

Each message shall be preceded by 'ZCZC $B_1B_2B_3B_4$ ' and followed by 'NNNN'.

The STS shall be of sufficient length for the measurements to be performed or it shall be possible to repeat the message (with the correct period of phasing between messages) without interruption for as long as is required for the test to be performed.

The level of the STS at the source including the associated network shall be -107dBm ($2\text{ }\mu\text{V}$ e.m.f. for an artificial antenna type a) and $5\text{ }\mu\text{V}$ e.m.f. for an artificial antenna type b)).

6.6 Standard test file

The standard test file (STF) shall consist of a series of unique identifiable messages each 500 characters long. The STF is intended to be used to fill the declared memory capacity of the EUT exactly and shall be downloaded directly into the EUT's memory via the INS port or some other method declared by the manufacturer.

6.7 Arrangement for test signal applied to the receiver input

Sources of test signals for application to the EUT input shall be connected through a network such that the impedance presented to the EUT input is equal to the impedance of the artificial antenna specified in section 6.8, irrespective of whether one or more test signals are applied to the EUT simultaneously.

In the case of multiple test signals, steps shall be taken to prevent any undesirable effects due to interactions between signals in the generators or other sources.

6.8 Artificial antennas

Where specified, tests shall be carried out with the EUT, connected as appropriate, to the following artificial antennas:

- a) a non-reactive resistance of 50 Ohms, or
- b) a resistance of 10 Ohms in series with a capacitance of 150 pF.

6.9 Measurement uncertainty

Absolute measurement uncertainties, maximum values:

Receiver sensitivity	$\pm 3\text{ dB}$
Conducted emission	$\pm 3\text{ dB}$
Radiated emission	$\pm 6\text{ dB}$

For the test methods according to this standard the uncertainty figures are valid to a confidence level of 95 %.

6.10 Interpretations of measurement results

The interpretation of the results recorded in a test report for the measurements described in this standard shall be as follows:

- a) the measured value related to the corresponding limit shall be used to decide whether an EUT meets the requirements of the standard;
- b) the measurement uncertainty value for the measurements of each parameter shall be stated in the test report; and
- c) the recorded value of the measurement uncertainty shall, for each measurement, be equal to or lower than the figures in 6.9.

6.11 E M C test exclusion bands

The frequencies on which NAVTEX receivers are intended to operate, shall be excluded from conducted and radiated RF immunity tests.

There shall be no frequency exclusion bands applied to emission measurements of NAVTEX receivers, and/or associated ancillary equipment.

The immunity test exclusions are referred to as "exclusion bands" and are defined in section 6.11.1.

6.11.1 Exclusion bands for receivers

The exclusion band for NAVTEX receivers operating at 518 kHz is the frequency range 490 kHz to 546 kHz.

The exclusion band for NAVTEX receivers operating at 490 kHz is the frequency range 462 kHz to 518 kHz.

The exclusion band for NAVTEX receivers operating at 4209,5 kHz is the frequency range 3969 kHz to 4449 kHz.

6.12 Narrow band responses on receivers

The requirements of IEC60945 Clause 10 shall apply with the following modifications.

No immunity tests shall be carried out on frequencies of identified narrow band responses on NAVTEX receivers.

An increase of the Character Error Rate (CER) above the value of 4 % shall be used as criterion for the identification of narrow band responses.

The nominal frequency offset to be used for the identification of narrowband responses shall be ± 1 kHz for the first part of the identification procedure, and $\pm 1,25$ kHz for its second part.

All narrowband responses shall be disregarded from immunity tests.

7 IEC 60945 tests required

The EUT shall be subjected to the tests in IEC 60945 required for equipment protected from exposure to weather as described in section 7.5 of this document, unless the manufacturer has stated that the equipment is intended for use in exposed locations in which case rain and spray testing is also required. When a requirement in this standard is different from IEC 60945, the requirement in this standard shall take precedence.

7.1 Ergonomics and HMI

Refer to IEC60945 Clause 6.1.

The EUT shall be checked to ensure compliance with the specific requirements as detailed below. The checks carried out shall be described and the results noted in the test report.

7.1.1 General

A check shall be made that all modes of operation as required by section 5 of this document are available.

7.1.2 Arrangement

Check that the number of operational controls, their design and manner of function, location, arrangement and size provide for simple, quick and effective operation of the EUT as defined in section 5.

Check that all indicators associated with controls, are readily distinguishable, correctly indicate the associated function and meet the requirements of section 5.

7.1.3 Operation

Check that all operational controls are arranged in a manner which minimises the chance of incorrect operation. Check that any controls not required for normal operation and which may affect performance are not readily accessible. Check all operational controls and indications for ease of use and correctness, and for general suitability related to their function and environment.

7.1.4 Identification

(see 5.6.5)

Check that all operational controls and indicators comply with the marking requirements of this specification. Check that instrument and indicator character type is simple and clear. The character height shall not be less than 3,5 mm, and the nominal character width shall be 0,7 times the character height.

Check that the controls and indicators are identified in English.

7.1.5 Screen display and indicators

This section is only applicable to EUTs with integral displays.

Check that the illumination of display and indicators is dimmable and can be switched off or that a night mode of display operation is provided that minimises the light output from the display.

Check that the display contrast is adjustable either automatically or manually.

Check that the display and indicators are clearly visible over the declared operating temperature range.

7.1.6 Voice announcement

This section is not applicable to the EUT.

7.1.7 Safety of operation

Check that all actions that may be irreversible require confirmation before proceeding.

Check that the EUT makes use of any quality indication contained in the input from other systems or sources.

Check that the INS input port requires that all sentences contain a valid checksum.

Check that the INS output port generates sentences that contain a valid checksum.

7.2 Hardware

Refer to IEC 60945 Clause 6.2.

The EUT shall be checked to ensure compliance with the specific requirements as detailed below. The checks carried out shall be described and the results noted in the test report.

7.2.1 General

Check that provision has been made for the removal of, or for blocking off of, the position of controls of any optional facilities which are not fitted.

Check that operational controls, the inadvertent exercise of which could switch off the equipment, are specially protected against unintentional operation.

Check that the design of the EUT is such that misuse of the controls required for normal operation, and which are accessible to the operator, shall not cause damage to the equipment or injury to personnel.

7.2.2 Alarms and indicators

Check that the EUT is provided with facilities which permit self testing and indication of a successful or unsuccessful self test as required by section 5.3.10. Check that alarm indications are red, or if on displays, red or otherwise highlighted.

Check that warning and alarm indications show no self-illumination, except to outline the alarm area on CRT or LCD displays, in the "safe" condition, and that any indirect illumination is low enough to avoid false indications.

7.2.3 Illumination

Check that any illumination provided in the EUT is adequate for operation of the EUT under all expected conditions of ambient illumination.

Check that the illumination can be adjusted for night use so that the night vision of the officer of the watch is not harmed by it.

Check that means are provided for dimming the output of any light source of the EUT which is capable of interfering with navigation.

Check that warning and alarm indicator lamps cannot be dimmed below reading intensity.

Check that the illumination is dazzle-free and adjustable to extinction, except for those warning and alarm indicators which are illuminated in the warning/alarm condition, and indicators required for equipment reactivation or distress alerting, which are to be clearly visible in all appropriate conditions of ambient illumination.

Check that controls which are not illuminated, such as tracker balls, are locatable easily and unambiguously by tactile means.

Check that all information is presented with high contrast on a low-reflectance background which emits negligible light at night.

Check that transparent covers to instruments cannot cause reflections which reduce readability to an unacceptable level.

Check that adjustable dimming from full brightness is provided for all lamps which are to be used in conditions of varying ambient illumination.

7.3 Software

Refer to IEC 60945 Clause 6.3.

7.3.1 General

Check documentation for compliance with IEC 60945 Clause 4.2.3.1.

Safety of operation

Check documentation for compliance with IEC 60945 Clause 4.2.3.2.

Check that software defaults, where applicable, are inserted in all modes of operation and that the default value:

- facilitates the preferred or expected operation of the equipment in accordance with the applicable equipment standards,
- does not lead to an unexpected or invalid operation, and
- has the effect of minimising the number of inputs or transmissions into the system under which it operates.

Check that the software prevents an operation or warns an operator when attempting an input that leads to an invalid operation of the equipment. Check that operations not required for normal operation, or which may adversely affect system performance, are not readily accessible.

7.3.2 Monitoring

Check documentation for compliance with IEC 60945 Clause 4.2.3.3.

7.3.3 Operation

Check documentation for compliance with IEC 60945 Clause 4.2.3.4.

7.3.4 Inter-unit connection

Check with the manufacturer of the EUT, using equipment documentation if necessary, that when it is connected to, and operating with, an INS, ECDIS or other navigational aid, arrangements have been provided to maintain the performance of the EUT and of the other equipment. In particular:

- a) Check that the software interfaces between the EUT and other equipment are tested, and that special test software is provided for this purpose if necessary.
- b) Ensure that arrangements have been made to achieve electrical separation and isolation between the EUT and the INS, if appropriate, such as by checking that:
 - 1) an exchange of any signals between units is carried out with minimum effect on the signal source,
 - 2) there is no loading of circuits or mismatch of transmission lines, particularly on high frequency or fast-rise time signals, and
 - 3) a capability exists of sustaining a 1 kV isolation between units of equipment.

Compliance with this paragraph may be demonstrated by testing using the new sentences defined in Annex C. These sentences define the interface protocol between the EUT and INS, ECDIS or other navigational aids.

7.4 Power supply tests

Refer to IEC60945 Clause 7.

7.4.1 Extreme power supply

Tests and performance checks at extreme power supply conditions shall be performed under the environmental conditions indicated in table 2.

Table 2 – Schedule of performance tests and checks

Environment	Normal power supply	Extreme power supply
Dry heat	PT	PC
Damp heat	PC ¹	-
Low temperature	PT	PC
Normal temperature	PT	PT
¹⁾ Only where the EUT does not contain an integral printer		

Where required, tests under extreme power supply conditions shall be a combination of dry heat and upper limit of supply voltage applied simultaneously and low temperature and lower limit of supply voltage applied simultaneously.

During type testing the power source to the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages.

These tests may be carried out at the same time as the environmental tests defined in section 7.5.

7.5 Durability and resistance to environmental conditions

Refer to IEC 60945 Clause 8.

Before making measurements at extreme temperatures, the EUT shall have reached thermal balance in the test chamber. The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled, so that excessive condensation does not occur.

The EUT shall be subject to a Performance Check (PC) under extreme test conditions to verify its operation. Unless otherwise stated, such performance checks shall be made with the extremes of temperature and voltage applied simultaneously.

Extreme test conditions shall be those specified in IEC 60945 clause 8 for protected equipment (class B), unless otherwise stated.

Table 3 - Extreme test conditions

Clause	Test condition
dry heat temperature	+55 °C ± 3 °C
Damp heat	+40 °C ± 3 °C temperature and 93 % ± 2 % relative humidity
low temperature	-15 °C ± 3 °C
Voltage variation	±10 % for a.c.; +30 % / -10 % for batteries and d.c. supplies
frequency variation	±5 % for a.c. supply

The environmental tests shall be performed in the order stated below. Waivers (for example Corrosion), where allowed by IEC 60945, are permitted.

- a) Dry heat
- b) Damp heat
- c) Low temperature
- d) Vibration
- e) Rain and spray
- f) Corrosion

The following tests shall be made under environmental conditions as detailed in IEC 60945:

Table 4 – Required environmental tests

	EUTs with integral printers		EUTs without integral printers	
	Test required during test	Test required after test	Test required during test	Test required after test
a) dry heat cycle	PT	-	PT	-
b) damp heat cycle	-	PC	PC	-
c) low temperature cycle	PT	-	PT	-
d) vibration	PC	-	PC	-
e) rain & spray	-	-	PC ¹⁾	-
f) corrosion	-	PC	-	PC
¹⁾ Only where the manufacturer has declared the product as 'exposed' category in IEC 60945				

For an EUT with integral printer sufficient time for drying shall be allowed after tests for dampness, particularly for printing media if supplied.

The manufacturer shall produce evidence that the components, materials and finishes employed in the EUT would satisfy the corrosion test.

7.6 Electromagnetic emissions

Tests for EMC emissions shall be performed in accordance with IEC 60945 clause 9 as detailed in 7.8.

7.7 Immunity to electromagnetic environment

Tests for EMC immunity shall be performed in accordance with IEC 60945 clause 10 as detailed in 7.8.

7.8 EMC tests

Performance criteria for protected equipment in IEC 60945 are defined in the table below.

Table 5 – Performance criteria in IEC 60945

IEC 60945 Tests	Protected
9.2 Conducted Emissions on Power Supply Port	Yes
9.3 Radiated Emissions from Power all Ports	Yes
10.3 Immunity to Conducted Interference (all ports)	Yes ¹⁾
10.4 Immunity to Radiated Interference	Yes ¹⁾
10.5 Immunity to Fast Transients	Yes ^{2) 3)}
10.6 Immunity to Surges on AC Power Lines	Yes ²⁾
10.7 Immunity to Power Supply Short Term Variations	Yes ²⁾
10.8 Immunity to Power Supply Failure	Yes
10.9 Immunity to Electrostatic Discharge	Yes ²⁾
¹⁾ Performance Criterion A applies ²⁾ Performance Criterion B applies ³⁾ DC Power Port not tested	

NOTE:

Performance Criterion A

No degradation of performance or loss of function is allowed, the product shall operate continuously at the level defined in the PT during the test.

Performance Criterion B

The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed after the test. During the test, degradation or loss of function or performance which is self-recoverable is allowed, but no change of actual operating state or stored data is allowed.

8 Serial interface tests

(see 5.4)

8.1 INS input electrical tests

8.1.1 Method of test

The INS Input Port configured in accordance with IEC 61162-1/-2, shall be tested according to the relevant standard with regard to minimum and maximum voltage and current at the input terminals.

8.1.2 Required results

The interfaces shall fulfil the applicable requirements of IEC 61162-1/-2.

8.2 INS input performance tests

8.2.1 Method of measurement

Operate the input with simulated data that represent the receiver control functions defined in Annex C, including messages with invalid and unavailable data formatters. This test shall include loading the EUT input with 100 % of the interface's capacity for a period not less than 5 minutes. Check for correct operation of the EUT.

8.2.2 Required results

Verify that the displayed data / EUT operation agrees with the simulated input data and that invalid and unavailable data formats do not stop/inhibit the correct operation of the EUT.

8.3 INS output electrical tests

8.3.1 Method of test

The INS Output Port configured in accordance with IEC 61162-1/-2, shall be tested according to the relevant standard with regard to minimum and maximum voltage and current driving capability at the output terminals.

8.3.2 Required results

The interfaces shall fulfil the applicable requirements of IEC 61162-1/-2.

8.4 INS output performance tests

8.4.1 Method of measurement

Set the EUT to output to the INS port such that it is loaded with 100 % of the interface's capacity. Check for correct operation of the EUT.

8.4.2 Required results

Verify that the output data / EUT operation agrees with the requested output data.

8.5 Printer output electrical tests

These tests are only applicable for EUTs that do not contain an integral printer.

These tests shall be conducted against the standard that the manufacturer has declared this interface will meet.

8.5.1 Method of test

The Printer Output Port configured in accordance with the manufacturer's data, shall be tested according to the relevant standard with regard to minimum and maximum voltage and current driving capability at the output terminals.

8.5.2 Required results

The interfaces shall fulfil the applicable requirements of the relevant standard.

8.6 Printer output performance tests

8.6.1 Method of measurement

Set the EUT to output to the Printer port such that it is loaded with 100 % of the interface's capacity. Check for correct operation of the EUT.

8.6.2 Required results

Verify that the output data / EUT operation agrees with the requested output data.

9 General & signal processing tests

9.1 Exclusion of stations

(See 5.3.1)

9.1.1 Method of measurement

The EUT shall be programmed to select all B_2 characters and specific B_1 characters.

A test signal +6 dB relative to the STS level, with the B_1 and B_2 characters varied at random over 25 repetitions of the STS, shall be applied to the EUT. $B_3B_4 = 00$ shall not be used.

The test shall be repeated for other selected B_1 characters.

9.1.2 Results required

For each value of B_1 not selected, the EUT shall neither display nor print the test message.

9.2 Exclusion of message categories

(See 5.3.1)

9.2.1 Method of measurement

The EUT shall be programmed to select all B_1 characters and specific B_2 characters.

A test signal +6 dB relative to the STS level, with the B_1 and B_2 characters varied at random over 25 repetitions of the STS, shall be applied to the EUT. $B_3B_4 = 00$ shall not be used.

The test shall be repeated for other selected B_2 characters.

9.2.2 Results required

The EUT shall display or print the messages with the currently programmed B_2 characters, and also the messages with the B_2 characters A, B, D and L.

9.3 Receiver test facility

(See 5.3.10)

9.3.1 Method of measurement

By inspection of the manufacturer's test data and documentation and actuating the test facility.

9.3.2 Results required

The test display/print-out shall contain at least 36 valid characters and an indication of whether the test passed or failed.

The test data shall be displayed but not stored in memory.

9.4 Search and rescue (SAR) alarm provision and reset

(See 5.3.9)

9.4.1 Method of measurement

An STS with $B_2 = D$ is input to the EUT once only.

9.4.2 Results required

An alarm shall be activated. The EUT shall be examined for the means whereby an alarm is generated.

It shall be demonstrated that this alarm can be reset manually via the user interface in the case of an EUT with integral display.

It shall be demonstrated that this alarm can be reset via the INS port and the use of the IEC 61162 'ACK' sentence.

The audible level of the alarm signal shall be measured to be between 75 – 85 dBA.

9.5 Additional alarms

(See 5.3.9)

9.5.1 Method of measurement

The manufacturer shall declare any additional alarms available.

9.5.2 Results required

It shall be demonstrated that such additional alarms can be suppressed.

It shall be demonstrated that such additional alarms can be reset.

10 Receiver tests

The following tests shall be repeated at each of the manufacturer's stated supported frequencies in turn.

10.1 Call sensitivity

(See 5.5.3)

10.1.1 Definition

The call sensitivity of the receiver is a defined level of the radio-frequency signal at which the receiver gives a character error ratio better than a defined value.

10.1.2 Method of measurement

An STS repeated 25 times shall be connected to the EUT by an appropriate artificial antenna as specified in 6.8 at a level of -107dBm ($2\text{ }\mu\text{V}$ for artificial antenna type a) or $5\text{ }\mu\text{V}$ for artificial antenna type b)).

10.1.3 Results required

The character error rate shall be $\leq 4\%$.

10.2 Interference rejection and blocking immunity

10.2.1 Definition

Interference rejection and blocking immunity is the receiver's ability to discriminate between the wanted signal and unwanted signals on frequencies outside the receiver's pass band.

10.2.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in a) in clause 6.8.

Two signals shall be applied to the EUT as specified in 6.7. The wanted signal shall be an STS +6 dB relative to the STS level, repeated 25 times.

The unwanted signal shall be un-modulated. The levels shall be as defined in Table 6 below. Suitable means shall be used to examine responses to interference.

Table 6 - Unwanted signal levels

Test step	490kHz receiver		518kHz receiver		4209,5kHz receiver	
	Frequency Range	Level	Frequency Range	Level	Frequency Range	Level
Test 1	489-489,5 kHz	+20 dB	517-517,5 kHz	+20 dB	4208,5-4209 kHz	+20 dB
Test 2	490,5-491 kHz	+20 dB	518,5-519 kHz	+20 dB	4210-4210,5 kHz	+20 dB
Test 3	487-489 kHz	+40 dB	515-517 kHz	+40 dB	4206,5-4208,5 kHz	+40 dB
Test 4	491-493 kHz	+40 dB	519-521 kHz	+40 dB	4210,5-4212,5 kHz	+40 dB
Test 5	100-515 kHz	+70 dB	100-515 kHz	+70 dB	100-4206,5 kHz	+70 dB
Test 6	493 kHz-30 MHz	+70 dB	521 kHz-30 MHz	+70 dB	4212,5 kHz-30 MHz	+70 dB
Test 7	156-174 MHz	+70 dB	156-174 MHz	+70 dB	156-174 MHz	+70 dB
Test 8	450-470 MHz	+70 dB	450-470 MHz	+70 dB	450-470 MHz	+70 dB

10.2.3 Results required

The unwanted signal shall not induce a character error rate > 4% in any of the received messages.

10.3 Co-channel rejection

10.3.1 Definition

The co-channel rejection is the receiver's ability to receive a wanted signal in the presence of an unwanted signal, with both signals being at the nominal frequency of the wanted channel.

10.3.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in a) in clause 6.8.

Two signals shall be applied to the EUT as specified in 6.7. The wanted signal shall be an STS +6 dB relative to the STS level, repeated 25 times. The unwanted signal shall be unmodulated at a level of -6 dB relative to the wanted signal, at the nominal EUT frequency.

10.3.3 Results required

The unwanted signal shall not induce a character error rate of > 4% in any of the received messages.

10.4 Intermodulation

10.4.1 Definition

Intermodulation is a process whereby signals are produced from two or more signals simultaneously present in a non-linear circuit.

10.4.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in a) in clause 6.8.

Three signals shall be applied to the EUT as specified in 6.7. The wanted signal shall be an STS +6 dB relative to the STS level. The two unwanted signals shall be unmodulated at equal levels of +70 dB relative to the wanted signal, outside of a guard band specified around the receive frequency.

The intermodulation frequency pairs shall include those defined in Table 7

Table 7 – Intermodulation frequency pairs

	490kHz		518kHz		4209,5kHz	
Test 1	488	486	516	514	4207,5	4205,5
Test 2	487	484	515	512	4206,5	4203,5
Test 3	486	482	514	510	4205,5	4201,5
Test 4	492	494	520	522	4211,5	4213,5
Test 5	493	496	521	524	4212,5	4215,5
Test 6	494	498	522	526	4213,5	4217,5

10.4.3 Results required

Intermodulation shall not induce a character error rate of > 4%.

10.5 Off frequency transmitter

10.5.1 Definition

The off frequency transmitter test is a check that the receiver performance is not compromised if the transmitter is operating off- frequency by up to 25 Hz.

10.5.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in a) in clause 6.8.

The STS at a level +6 dB relative to the STS level, shall be applied to the EUT for more than 3 min with the objective of obtaining sufficient confidence that the equipment is working correctly. The test shall be repeated with a shift of the selected receive frequency such that the total mark and space frequency error is 25 Hz.

10.5.3 Results required

The test signal shall not produce in the EUT a character error rate of > 4 % for each tests.

10.6 Simultaneous operation on several receive frequencies

(See 5.5.1)

10.6.1 Definition

This test is a check that the receiver performance is not compromised if one of the other receivers is simultaneously receiving.

10.6.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in a) in clause 6.8.

As in 10.1 with two STSs set to two operating frequencies which the manufacturer has declared supported by the EUT, applied simultaneously to the EUT.

Apply one wanted STSs at a level +6 dB relative to the STS level and the other at a level of +50 dB relative to the STS level, each at one of the EUT's specified operating frequencies. The test shall be repeated for several combinations of receiver frequencies and power levels.

10.6.3 Results required

The display/print-out of the STS transmitted on each frequency shall have a character error rate of $\leq 4\%$.

10.7 Protection of input circuits

10.7.1 Method of measurement

An unmodulated signal at an e.m.f. level of 30 V r.m.s. shall be applied to the antenna input of the EUT, as specified in 6.7, for a period of 15 min on any frequency within 100 kHz to 28 MHz.

A performance check shall be carried out after the test signal is removed.

10.7.2 Results required

The EUT shall continue to operate normally.

11 Printer tests

11.1 Basic requirements

(see 5.7.1 and 5.7.5)

11.1.1 Method of measurement

The manufacturer shall declare the paper requirement and printing capacity of the EUT.

An STS shall be applied to the EUT.

11.1.2 Results required

The declarations in Annex D shall be consistent with a minimum paper and printing capacity of 200 000 characters.

The EUT print-out shall have at least 32 easily legible characters per line. The acoustic noise shall be ≤ 60 dBA at a distance of 1 m from any part of the equipment.

11.2 Paper roll end alarm and storage inhibition

(See 5.7.5)

11.2.1 Method of measurement

The printer shall be set up such that while the STS is received the paper-end alarm is activated.

An STS +6 dB relative to the STS level, with its message content repeated 25 times, shall be applied to the EUT. A new paper roll is then inserted into the printer. One further identical STS shall be applied to the EUT.

11.2.2 Results required

The paper-end alarm shall be activated when the paper is running out.

The EUT shall neither print out the initial (for example 25 times long) test message nor store the associated message identifications.

After insertion of the new roll of paper, the EUT shall print out the (one) extra test message.

11.3 Automatic line-feed indication and paper feed

(See 5.7.2)

11.3.1 Method of measurement

The manufacturer shall declare the number of characters per line for the EUT. The STS shall be applied to the EUT with a message containing more characters than the declared characters per line.

11.3.2 Results required

Any division of a word by an automatic line feed shall be indicated in the print-out.

There shall be two line feeds at the end of the message.

11.4 Mutilated character indication

(See 5.7.4)

11.4.1 Method of measurement

ITU-R Recommendation M.625 annex I, 4.6.5 defines the conditions under which a character is defined as mutilated. A test signal shall be applied to the EUT containing randomly mutilated characters in the message.

11.4.2 Results required

The print-out shall contain an asterisk for each mutilated character.

11.5 Tests of technical characteristics (ITU-R Recommendation M.540)

11.5.1 B₁/B₂ characters selection

(See 5.3.1)

These tests are in sections 9.1 and 9.2.

11.5.2 Printer activation/error-free preamble B₁-B₄

(See 5.3.3)

11.5.2.1 Method of measurement

The EUT shall be programmed to select specific B_1 and B_2 characters.

An STS shall be input to the EUT with the B_1 , B_2 , B_3 and B_4 message identification characters mutilated in turn.

11.5.2.2 Results required

The EUT shall neither store the message identifications nor print out the messages.

11.5.3 Non-repetitive printing of a message

(See 5.3.4)

This test is covered by section 12.3.

11.5.4 Message with $B_3B_4 = 00$

(See 5.3.5)

11.5.4.1 Method of measurement

The EUT shall be programmed to select a specific B_1 character.

An STS +6 dB relative to the STS level, with $B_3B_4 = 00$ and with the selected B_1 and then with a B_1 not selected, shall be applied to the EUT.

11.5.4.2 Results required

The EUT shall always print the test message.

12 Memory tests

These tests require that the manufacturer provides a method of deleting all stored messages via a method unavailable to the end user. The manufacturer shall also provide a 'standard test file' STF which shall be used to pre-load and 100 % fill the non-volatile message memory, and a method of loading this file into memory.

The message storage capacity shall be declared by the manufacturer.

The EUT must be configured to display/print the stations & message types used in the test.

12.1 Internal storage, message tagging and erasure of oldest message identifications

(See 5.8.1.3)

This test is not required for EUTs with integral printers and can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.1.1 Method of measurement

- a) The STF shall be used to pre-load and 100 % fill the non-volatile message memory. The size of this file shall be defined by the manufacturer and the last message shall be MSGn.
- b) The 5 oldest messages shall then be tagged for permanent retention.
- c) A test script consisting of 10 unique identifiable messages each 500 characters long shall be sent to the EUT.

- d) The tagged messages shall then be untagged and a new test script of ten unique messages (MSG 211-220) shall then be sent to the EUT.

12.1.2 Results required

The following results are required.

- a) A check of the EUT shall indicate that all messages of the STF have been stored.

NAVTEX messages stored
MSG1
MSG2
⋮
MSGn

- b) The EUT shall be checked to ensure it has correctly tagged the messages.

NAVTEX messages stored
MSG1 TAG
MSG2 TAG
MSG3 TAG
MSG4 TAG
MSG5 TAG
MSG6
⋮
MSGn

- c) A check of the EUT shall indicate that all messages of the test script have been stored, that the first (oldest) 5 tagged messages are still stored and that the next 10 oldest messages of the STF are no longer stored.

NAVTEX messages stored
MSG1 TAG
MSG2 TAG
MSG3 TAG
MSG4 TAG
MSG5 TAG
MSG16
⋮
MSGn
MSGn+1
⋮
MSGn+10

- d) A check of the EUT shall indicate that the 10 oldest messages have been replaced by the 10 new messages

NAVTEX messages stored
MSG21
MSG22
MSG23
MSG24
MSG25
MSG26
MSGn
MSGn+1
MSGn+20

12.2 Erasure of message identifications/storage time

(See 5.8.1.3)

This test is required for EUTs that do not contain an integral printer and can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.2.1 Method of measurement

After the test of 12.1 wait 59 h and then apply to the EUT one more message with a specific message identification previously used and currently stored in the EUT. At the same time tag another of the previously used messages for permanent retention. Wait another 2 hours and apply a new previously unused message 'A'. Check the contents of non-volatile message storage. Wait another 12 h, check the contents of non-volatile message storage. Then again apply the test script of 12.1 with the message identifications previously used. Check non-volatile storage for the last time.

12.2.2 Results required

A check of the EUT shall indicate that the message applied after 59 h was not stored and did not overwrite any of the stored contents of the EUT.

A check of the EUT shall indicate that the message 'A' applied after 61 h was stored and overwrote the oldest message stored in the EUT.

A check of the EUT after 73 h shall indicate that only message 'A' and the message tagged for retention are stored in the EUT.

After applying the test script the EUT shall contain the contents of the test script, and the message tagged for retention.

12.3 Storage of message identifications

(See 5.8.2)

This test is required for EUTs with an integral printer only and can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.3.1 Method of measurement

An STS is applied to the EUT. The test signal shall be so composed that the message identification is correct. The signal shall contain a character error rate of $\leq 4\%$. The STS shall be repeated 35 times with unique message identification for each transmission.

After the first part of this test wait 59 h and then apply to the EUT one more message with a specific message identification previously used and currently stored in the EUT. Wait another 2 hours and apply a new previously unused message 'A'. Check the contents of non-volatile message storage. Wait another 12 h, check the contents of non-volatile message storage. Then again apply the test script with the message identifications previously used. Check non-volatile storage for the last time

12.3.2 Results required

The print-out or display of the test messages shall be examined and the character error rate shall not exceed 4 %. The message identifications shall be stored.

A check of the EUT shall indicate that the message applied after 59 h was not stored and did not overwrite any of the stored contents of the EUT.

A check of the EUT shall indicate that the message 'A' applied after 61 h was stored and overwrote the oldest message stored in the EUT.

A check of the EUT after 73 h shall indicate that only message 'A' was stored in the EUT.

After applying the test script the EUT shall contain the contents of the test script and message A.

12.4 Reception of messages with character errors

(See 5.3.6)

This test is required for all EUTs and can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.4.1 Method of measurement

- a) An STS is applied to the EUT. The test signal shall be so composed that the message identification is correct. The signal shall contain a character error rate of $> 20\%$ and $\leq 33\%$. The STS shall be repeated 35 times with unique message identification for each transmission. There shall then be a check of the contents of message memory (for non-printing EUTs) or the print-out (printing NAVTEX).
- b) An STS with the same 35 message identifications shall be applied to the EUT. The signal shall contain a character error rate of $> 4\%$ and $\leq 20\%$. There shall then be a check of the contents of message memory (for non-printing EUTs) or the print-out (printing NAVTEX).

12.4.2 Results required

- a) The EUT shall store (non-printing EUTs) or print (printing EUTs) the 35 messages, each indicating character error rate of $> 20\%$ and $\leq 33\%$.
- b) The EUT shall store (non-printing EUTs) or print (printing EUTs) the 35 messages, each indicating character error rate of $> 4\%$ and $\leq 20\%$.

12.5 Unsatisfactory reception

(See 5.3.6)

This test is required for all EUTs and can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.5.1 Method of measurement

An STS is applied to the EUT. The test signal shall be so composed that the message identification is correct. The signal shall contain a character error rate of $> 33\%$. The STS shall be repeated 35 times with unique message identification for each transmission.

12.5.2 Results required

The EUT shall not store messages or message identifications. An EUT with an integral printer shall not print any of the test messages.

12.6 Power-off check

(See 5.3.8)

This test is required for all EUTs that do not contain an integral printer and can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.6.1 Method of measurement

The STF shall be loaded into the EUT. The power shall be removed for a period of 6 hrs. Power shall then be applied and the contents of the non-volatile message storage shall then be checked. The previously applied settings for transmitter coverage area (B_1) and message type (B_2) for each receiver and any other settings that the manufacturer has declared are non-volatile shall also be checked.

12.6.2 Results required

After a 6 hrs power-down cycle the EUT's non-volatile message storage shall contain the set of messages defined in the STF. All settings that the manufacturer has declared as non-volatile shall be unchanged from before the power-off cycle.

12.7 Brown-out test

(see 5.9)

This test is required for all EUTs.

This test simulates the situation where the nominal supply voltage drops to below acceptable levels and then recovers over a medium time period. This is consistent with the performance of a flat or unhealthy battery when an engine is started. The unit shall not enter into any undefined or undesirable state.

12.7.1 Method of measurement

Operate the EUT at the nominal supply voltage as indicated by the manufacturer.

Gradually reduce the supply voltage to 40% of the nominal supply voltage over a time period of 30s.

Gradually increase the supply voltage back to 80% of the nominal supply voltage over a time period of 30s.

The contents of the EUT's message and/or message identification memory, settings for transmitter coverage area (B_1) and message type (B_2) for each receiver and any user settings declared non-volatile by the manufacturer shall be inspected prior to and after a power supply brown-out condition.

12.7.2 Results required

After a power supply brown-out the EUT's non-volatile message storage shall contain the set of messages defined in the STF. All settings that the manufacturer has declared as non-volatile shall be unchanged from before the brown-out condition.

12.8 UTC handling check

(see 5.15)

This test is required for all EUTs that do not contain an integral printer and but only when the manufacturer has declared that the EUT can use a source of time (for example UTC from an external source or an internal RTC). The test can be conducted using any combination of the declared receive frequencies as the source of test messages.

12.8.1 Method of measurement

An external source of UTC shall be applied as defined by the manufacturer. The STF shall be loaded into the EUT. The power shall then be removed for a period of 6 hrs. Power shall then be applied for 53 hrs and the contents of the non-volatile message storage shall then be checked.

12.8.2 Results required

After a 6 hrs power-down cycle the EUT's non-volatile message storage shall contain the set of messages defined in the STF.

13 Miscellaneous tests

13.1 Spurious emissions

Spurious emissions are any radio-frequency emissions generated in the EUT and radiated by conduction from the antenna.

13.1.1.1 Method of measurement

The EUT shall be connected to the artificial antenna specified in 6.8 and the r.m.s. value of any component of the spurious emissions shall be measured. The measurements shall cover the frequency range from 9 kHz to 2 GHz.

13.1.1.2 Results required

The power of any discrete component shall be $\leq 1 \times 10^{-9}$ W.

13.2 Special purpose and safety tests

Tests for Special Purposes and Safety shall be performed as specified in IEC 60945 clauses 11 and 12. Waivers as indicated in IEC 60945 shall apply. In addition the clause 12.4 of IEC 60945 (X-radiation) is not applicable to the EUT.

13.3 Maintenance

Checks shall be made to ensure that the equipment has been so constructed and designed for installation such that it is readily available for inspection and maintenance purposes.

13.4 Equipment manuals - checks of the manufacturer's documentation

In addition to checking that the requirements of 5.13 and Annex D are met, the manufacturer shall submit to the test laboratory sufficient technical documentation of the EUT to define its interfaces.

The following checks shall be made for the input port, if applicable:

- approved sentences against IEC 61162-1 and/or -2 and the requirements of Annex C of this document
- proprietary sentences (if any) against IEC 61162-1 and/or -2
- transmission intervals and baud rates against IEC 61162-1 and/or -2
- load on the line of inputs
- electrical isolation of input circuits

The interface connections required shall be clearly identified in the operator manual or other appropriate literature. This shall include identification of A and B signal lines for IEC61162 interfaces.

In addition the manuals shall include the needed information for correct siting of the antenna(s).

13.5 Marking and identification

The markings on the EUT shall include details of the power supply from which the equipment is intended to be operated as well as those specified in 5.14 and IEC 60945 Clause 4.9.

The interface connections required shall be clearly identified in the operator manual or other appropriate literature. This shall include identification of A and B signal lines for IEC 61162 interfaces.

Annex A (Informative)

Block diagrams of NAVTEX systems

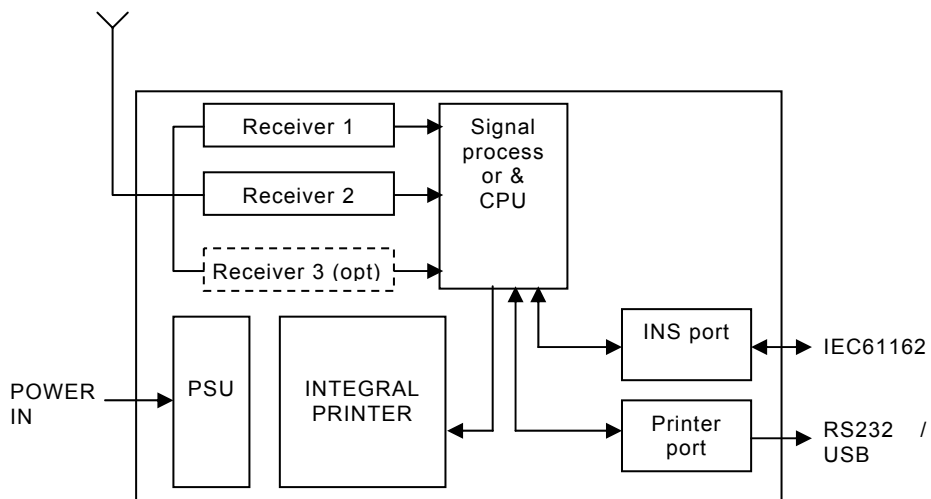


Fig A1- EUT with an integral printing device

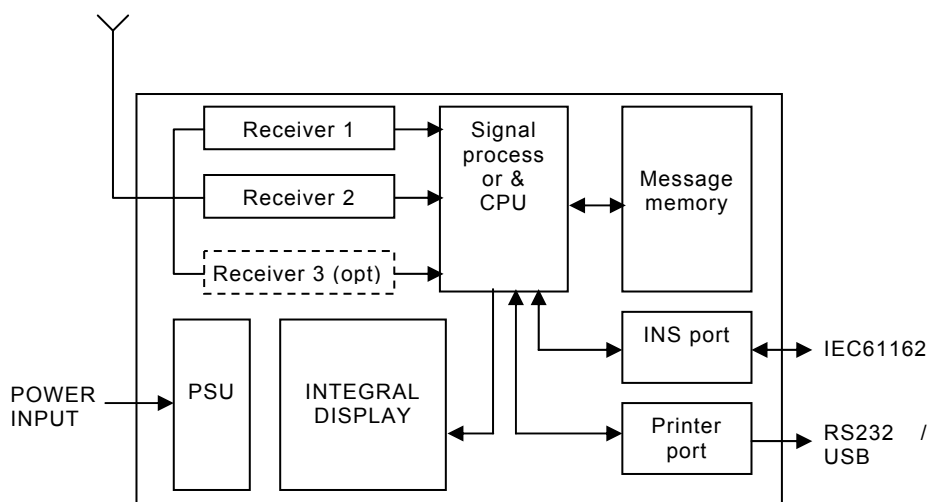


Fig A2- EUT with an integral display device

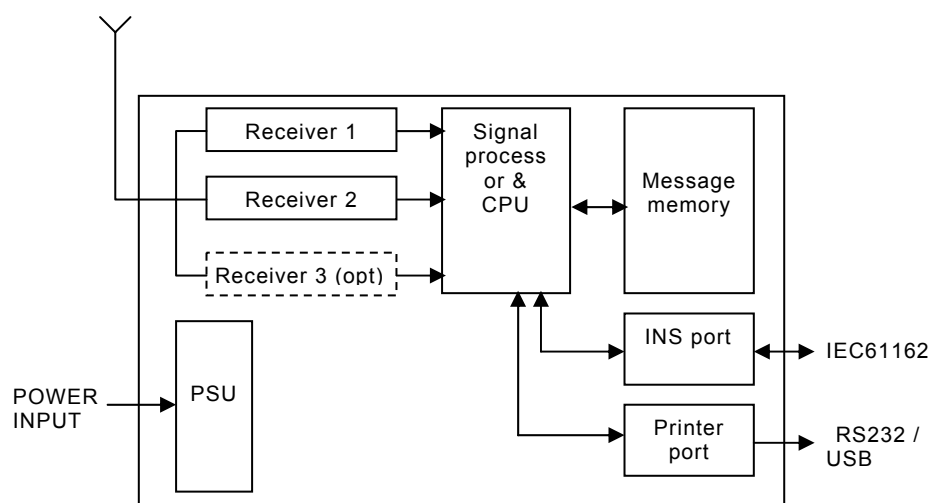


Fig A3 - EUT black box receiver

Annex B

(Normative)

Definition of satisfactory reception of a message

B.1 Satisfactory reception of a message

(148/A.6.2.3) *Only messages or message identifications which have been satisfactorily received shall be stored; a message is satisfactorily received if both:*

- a) the character error rate is ≤ 4 %; and*
- b) the received character error rate does not exceed 33 % for more than 5 s.*

B.2 Character error rate

The Character Error Rate (CER) shall be defined as:

$$\text{CER} = (100 \times \text{errors}) / \text{total characters}$$

CER shall be calculated for each complete message.

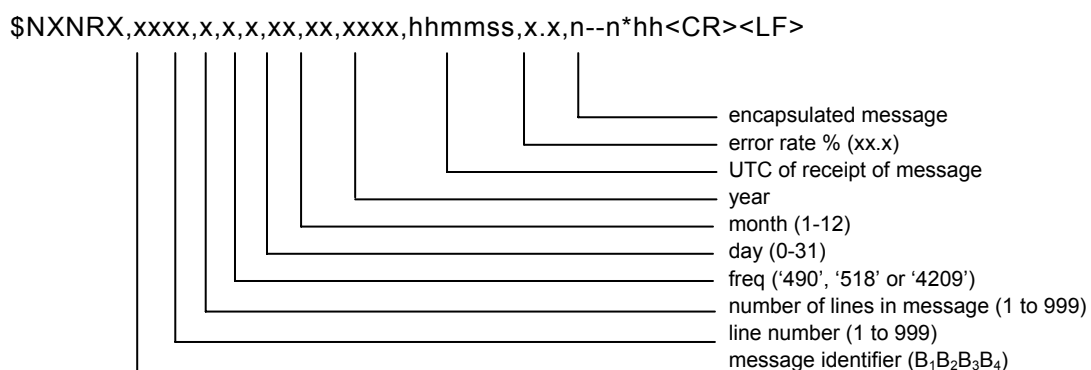
CER shall be rounded up to the nearest integer. For example a single error in a message of less than 100 characters shall result in a CER of 1 %.

Annex C (Normative)

New IEC 61162 sentences due to NAVTEX

C.1 NRX – New NAVTEX received message

New NAVTEX message to follow in ASCII format



The first NRX sentence transmitted for a particular NAVTEX message shall contain valid data for all fields. For subsequent NRX sentences encapsulating a NAVTEX message, all fields apart from 'message identifier', 'line number' and 'encapsulated message' are optional. If UTC time or date are not known then the fields are NULL.

Example usage:

```
$NXNRX,TA21,1,4,518,10,01,2005,102000,2.2, 291600 UTC JAN =*hh
$NXNRX,TA21,2,4,,,,,,OOSTENDERADIO – INFO 37/04 =*hh
$NXNRX,TA21,3,4,,,,,,WESTHINDER ANCHORAGE, ANCHOR LOST IN*hh
$NXNRX,TA21,4,4,,,,,,POSITION 51-24.94N 002-40.02E.+*hh
```

Example usage when no UTC is available to the equipment:

```
$NXNRX,TA21,1,4,518,,,,,2.2, TEST MESSAGE*hh
```

Where the NAVTEX message contains reserved characters as defined in IEC 61162-1, then these shall be handled by using ASCII 'escape code' :

c) Reserved character	ASCII escape code
d) <CR>	^0D
e) <LF>	^0A
f) \$	^24
g) *	^2A
h) ,	^2C
i) !	^21
j) \	^5C
k) ^	^5E
l) ~	^7E

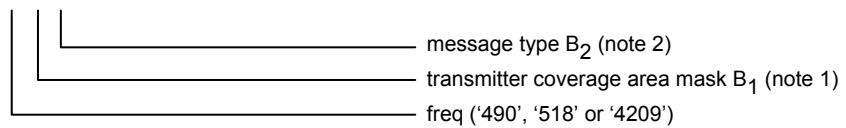
The 'audible alarm' (Table 1, combination number 10) and 'who are you' (Table 1, combination number 4) reserved characters as defined in ITU-R M.625-3 shall not be supported by non-printing NAVTEX equipment.

The 'audible alarm' (Table 1, combination number 10) reserved character as defined in ITU-R M.625-3 shall be supported by printing NAVTEX equipment.

C.2 NRQ – Request NAVTEX messages

Command to request specific NAVTEX message(s) to be sent to INS port. Messages may be sent in any order. Each message sent from the INS port shall be preceded by the NRX sentence.

\$NXNRQ,x,h,h*hh<CR><LF>



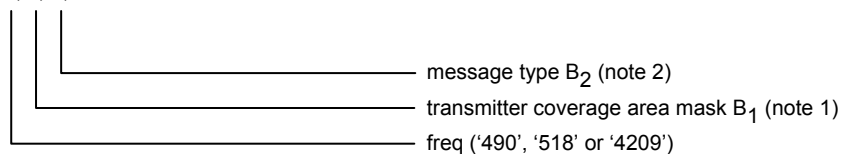
Note 1: the transmitter coverage area mask is defined as a 32 bit mask 0xFF.FF.FF.FF where the least significant bit represents transmitter coverage area 'A', the next bit is 'B' and so on up to bit 25 which is 'Z'. Bits 31-26 shall be set to '0'. To select a transmitter coverage area its corresponding bit shall be set to '1'; to deselect a transmitter coverage area its corresponding bit shall be set to '0'.

Note 2: the message type mask is defined as a 32 bit mask 0xFF.FF.FF.FF where the least significant bit represents message type 'A', the next bit is 'B' and so on up to bit 25 which is 'Z'. Bits 31-26 shall be set to '0'. To select a message type its corresponding bit shall be set to '1'; to deselect a message type its corresponding bit shall be set to '0'.

C.3 NMK – Set NAVTEX mask

Command to set B₁.B₂ mask for specific NAVTEX message(s) to be stored in internal message memory & echoed to the INS port.

\$NXNMK,x,h,h*hh<CR><LF>



Note 1: the transmitter coverage area mask is defined as a 32 bit mask 0xFF.FF.FF.FF where the least significant bit represents transmitter coverage area 'A', the next bit is 'B' and so on up to bit 25 which is 'Z'. Bits 31-26 shall be set to '0'. To select a transmitter coverage area its corresponding bit shall be set to '1'; to deselect a transmitter coverage area its corresponding bit shall be set to '0'.

Note 2: the message type mask is defined as a 32 bit mask 0xFF.FF.FF.FF where the least significant bit represents message type 'A', the next bit is 'B' and so on up to bit 25 which is 'Z'. Bits 31-26 shall be set to '0'. To select a message type its corresponding bit shall be set to '1'; to deselect a message type its corresponding bit shall be set to '0'.

Example usage:

\$NVNMK,518,00001E1F,00000023*42

This example specifies that message identifiers 'A', 'B' and 'F', received from transmitter areas 'A' to 'E' and 'J' to 'M' on 518 kHz shall be stored in the internal message memory and echoed to the INS port.

This command shall be used to select the required transmitter coverage area and message types to be stored in the EUT's memory. If the EUT is kept powered up while the INS is switched off then at INS power-up the INS can request 'ALL' messages using an NRQ sentence.

C.4 ACK & ALR – Acknowledge and set alarms

IEC 61162-1 standard commands shall be used to report and acknowledge SAR and other alarms on the EUT.

The Local alarm numbers shall be defined as:

- 1 Search and rescue alarm
- 2 Receiver 1 malfunction
- 3 Receiver 2 malfunction
- 4 Receiver 3 malfunction
- 5 General failure
- 6 Built in self test failure

Annex D

(Normative)

Manufacturer's declarations / equipment manual

The manufacturer shall make the following declarations / provide the following information in the User/Installation Manual.

- nominal supply voltage and frequency
- minimum & maximum supply voltage
- how the reception and storage of new messages other than SAR messages are indicated to the user
- the memory capacity of the unit in terms of the number of 500 character long messages
- whether the unit is IEC 60945 'protected' or 'exposed' category
- a list of available alarms
- the receiver frequencies which the unit operates on
- a list of user settings that are non-volatile
- whether the unit uses a source of time for handling message ageing (for example UTC from an external source or an internal RTC)
- operating temperature range
- storage temperature range
- INS port serial interface electrical and protocol standards & settings
- Printer port serial interface electrical and protocol standards & settings
- Provide an overview of the NAVTEX system
- Manufacturer recommendations, if any, on periodic functional testing and maintenance
- Warranty information
- A recommendation for mounting the unit
- Information relating to the shipment of the unit
- Information relating to the disposal of the unit at the end of its operational life
- a list of languages supported by the user interface